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IN THE UNITED STATES DISTRICT COURT

FOR THE NORTHERN DISTRICT OF CALIFORNIA

TRI-VALLEY CARES, MARYLIA KELLEY, JANIS KATE TURNER, and JEDIDJAH DE VRIES, Plaintiffs, vs. UNITED STATES DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION, and LAWRENCE LIVERMORE NATIONAL LABORATORY, Defendants	Case No. 08-cv-01372-SBA **PLAINTIFFS' REPLY TO DEFENDANTS' OPPOSITION TO PLAINTIFFS' MOTION FOR PRELIMINARY INJUNCTION** Date: May 6, 2008 Time: 1:00 p.m. Judge: Hon. Saundra B. Armstrong

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I. INTRODUCTION

The instant action concerns only the adequacy of the terrorism analysis ordered by the Court of Appeals for the Ninth Circuit in an earlier case, *Tri-Valley Cares v. Department of Energy*, and other legal claims that arose after the termination of the prior litigation. No. 04-17232, mem. op. at 4 (9th Cir. 2006). In a thinly guised effort to prejudice this Court's consideration of the merits of this action, Defendants have egregiously mischaracterized this case as an attempt to relitigate already-resolved issues. *See* Def. Br.

Plaintiffs' challenge to the adequacy of the new Environmental Assessment ("EA") for the proposed Biosafety Level 3 ("BSL-3") facility at Lawrence Livermore National Laboratory ("Livermore Lab" or "LLNL") is solely concerned with its terrorism analysis, a claim which clearly could not have been previously raised or litigated. *See* Pl. Br. at 11-16. Since the Ninth Circuit ordered "DOE to consider whether the threat of terrorist activity necessitates the preparation of an Environmental Impact Statement [("EIS")]," Plaintiffs' allegation that Defendants were required to prepare an EIS on the basis of the significant environmental impacts that may result from a terrorist attack is also not precluded. *Tri-Valley Cares*, No. 04-17232, mem. op. at 4. Plaintiffs' third claim, which concerns Defendants' failure to supplement the new EA, is plainly not precluded because this claim did not arise until after the conclusion of the earlier litigation. Finally, Plaintiff's claim regarding Defendants' issuance of a Finding of No Significant Impact ("FONSI") for the proposed facility without public review and comment in violation of applicable regulations is also not precluded because it concerns a FONSI that was not in existence at the time of the prior action.

Because Plaintiffs are likely to succeed on the merits of these claims and the balance of hardships tips sharply toward them, this Court should grant Plaintiffs' motion for preliminary injunction.

II. LEGAL STANDARD

In environmental cases, injunctive relief is "typically appropriate . . . because 'environmental injury, by its nature, can seldom be adequately remedied by money damages and is often permanent or at least of long duration, *i.e.*, irreparable.'" *N. Cheyenne Tribe v. Norton*,

503 F.3d 836, 843 (9th Cir. 2007) (quoting *Amoco Prod. Co. v. Vill. of Gambell*, 480 U.S. 531, 545, 107 S. Ct. 1396 (1987)). If such injury is sufficiently likely, "the balance of harms will usually favor the issuance of an injunction to protect the environment." *Amoco Prod. Co.*, 480 U.S. at 545.

Although this Court's review under the Administrative Procedure Act "is deferential, the agency must nonetheless 'articulate a rational connection between the facts found and the conclusions made.'" *Or. Natural Res. Council Fund v. Goodman*, 505 F.3d 884, 889 (9th Cir. 2007) (quoting *United States v. Louisiana-Pacific Corp.*, 967 F.2d 1372, 1376 (9th Cir. 1992)). Moreover, "if an agency 'fails to consider an important aspect of a problem . . . [or] offers an explanation for the decision that is contrary to the evidence,' its action is 'arbitrary and capricious.'" *Or. Natural Res. Council Fund*, 505 F.3d at 889 (quoting *Lands Council v. Powell*, 395 F.3d 1019, 1026 (9th Cir. 2005)).

III. ANALYSIS

Despite Defendants' assertions to the contrary, Plaintiffs have demonstrated that they are likely to prevail on the merits and that the balance of hardships tips sharply toward Plaintiffs.

A. Plaintiffs have demonstrated a likelihood of success on the merits

i. Failure to prepare an adequate EA and FONSI

In short, Defendants have failed to comply with the Ninth Circuit's remand to consider whether the threat of terrorist activity at the proposed LLNL BSL-3 facility necessitates the preparation of an EIS. *Tri-Valley Cares*, No. 04-17232, mem. op. at 4. Defendants postulate three types of terrorist threats for evaluation in the new EA: (1) facility damage or destruction from direct terrorist attacks that results in loss of containment; (2) the theft and subsequent release of a pathogenic material by a terrorist from outside LLNL; and (3) the covert theft and subsequent release of a pathogenic material by an insider with access to the facility. Pl. Exh. 6 at 58.

a. Facility damage or destruction resulting in loss of containment

Defendants' analysis of the first type of threat is based on the arbitrary and capricious assumption that a centrifuge accident involving a 1 liter slurry of *Coxiella burnetii* fully

encompasses the potential consequences of every possible malicious act designed to breach containment. *See* Pl. Exh. 6 at 54, 60. Defendants' errant conclusion is based on a number of faulty assumptions, including the failure to consider the environmental impacts of a terrorist attack during small-animal aerosol testing of bioagents and biotoxins.[1] *See* Pl. Exh. 6 at 7, 59-61. Because BSL-3 is applicable to "facilities in which work is done with infectious agents which may cause *serious or potentially lethal disease as a result of exposure by the inhalation route*," a loss of containment during aerosol testing presents risks that are distinct from those associated with a centrifuge accident involving a watery mixture of insoluble matter; risks that were not analyzed in the new EA. *See* Pl. Exh. 6 at 54, A-9 (emphasis added); Pl. Exh. ¶¶ 6, 10.

Furthermore, Defendants misunderstand and misstate Plaintiffs' argument with regard to the application of the bounding analysis of natural and catastrophic events to an analysis of the potential consequences of acts of sabotage or terrorism. *See* Def. Br. at 12-13. As Plaintiffs noted, DOE itself has acknowledged that such an application "may not be adequate for all situations, because *accident scenarios may not fully encompass potential threats posed by intentional destructive acts*." Pl. Exh. 13 at 2 (emphasis added). Thus, it is eminently reasonable to question whether the consequences malicious acts deliberately designed to breach containment are truly bounded by the accidents and natural events analysis evaluated in the original EA, as Defendants claim. Pl. Exh. 6 at 59.

Here, the bounding analysis from the original EA concerns a centrifuge accident within the proposed facility without any associated loss of containment, which is vastly different than a terrorist attack designed to breach containment. Pl. Exh. 6 at 54. Plaintiffs' self-evident observation that, in the event of a terrorist attack resulting in a loss of containment, air contained in the proposed facility would not be subject to HEPA filtration is not affected by the fact that "[t]he BSL-3 laboratories [contained in the proposed facility] would be under the most negative

[1] Defendants' consideration of the applicability of the bounding analysis entirely fails to mention that aerosol testing will be performed in the proposed facility when discussing "routine operations," despite Defendants' claim that the proposed facility is needed so LLNL will have "the capability to handle operations involving small-animal (rodent) challenges of bioagents (and possibly biotoxins)" on up to 100 rodents at a time. Pl. Exh. 6 at 7, 59; Def. Exh. 1 at 20.

pressure with respect to all other areas of the building." Def. Exh. 1 at 17. One can easily imagine any number of scenarios in which pathogenic material would be released without filtration following such a breach of containment, despite the routine negative pressurization of the proposed facility.[2] Furthermore, even though Defendants make much about the alleged implausibility of Plaintiffs' "light damage without a fire" scenario, the new EA itself briefly mentions just such a scenario, but arbitrarily and capriciously assumes, without justification, that an incident of this nature is likely to rupture containers of disinfectant, thereby reducing the amount of viable agent expected to escape the proposed facility. *See* Def. Br. at 13; Pl. Exh. 6 at 59.

With regard to Plaintiffs' assertion that the proposed LLNL BSL-3 facility could release bioagents against which available antibiotics may be ineffective, the facility is intended, in part, to perform testing and bioforensic analysis of pathogenic material released in a terrorist attack. *See* Def. Exh. 10; Def. Exh. 11. Defendants own declarant notes that the facility may test threat bioagents "for antibiotic susceptibility which could lead to additional deaths by not providing appropriate therapeutics." Def. Exh. 10 at ¶ 4. Obviously, if the proposed facility performs such testing or analysis on a threat bioagent with antibiotic resistance, a release of that agent, whatever the cause, could pose grave risks to the human environment that are not analyzed in the new EA.

Defendants repeatedly claim that the proposed BSL-3 facility at Livermore Lab is no different than any of the other existing BSL-3 facilities in the United States. *See* Def. Br. However, Defendants' own declarant notes that the proposed facility "will have confirmatory assays, approved sampling methods, and authorization to work with multiple agents of concern" to the Department of Homeland Security, which "is not the case for most BSL-3 laboratories in the country." Def. Exh. 5 at ¶ 6. Moreover, according to new EA, the proposed facility will

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[2] For instance, the proposed facility's HEPA filters or the fan(s) or generators maintaining negative pressure could be damaged or destroyed in a terrorist attack. Or, a terrorist attack could cause a power outage leading to the loss of negative pressure. An accidental power outage at the Centers for Disease Control and Prevention's state-of-the-art Biosafety Level 4 ("BSL-4") facility in 2007 led to just such a loss of negative pressure. Pl. Exh. 18.

have "the ability to produce small amounts of biological material (enzymes, DNA, ribonucleic acid [RNA], etc.) using infectious agents and genetically modified agents . . . ." Pl. Exh. 6 at 7. Whether such work is closely regulated, as Defendants allege, is immaterial. Def. Br. at 14. What is material is that a BSL-3 facility that conducts testing and analysis of bioagents used in terrorist attacks, which would likely be weaponized to some degree, is different than a typical BSL-3 facility. *See* Pl Exh. 3 at ¶¶ 5-6.[3] Finally, civilian and medical BSL-3 facilities typically do not store, work with, or aerosolize the same quantities and concentrations of pathogenic material as are planned for the proposed facility. *Id.* at ¶ 6.

b. Theft and subsequent release of pathogenic material by an outsider

Defendants discount the second type of threat by falsely claiming that the proposed facility is not an attractive target for an outside terrorist because the pathogenic material to be studied therein is readily obtainable from the environment. *See* Pl. Exh. 6 at 62-63. To reach this unsound conclusion, Defendants overlook the fact that the proposed BSL-3 facility will contain a diverse collection and large quantities of bioagents that could be used as bioweapons—including known strains of bioagents with demonstrated human virulence[4]—and may receive and produce genetically modified microorganisms that could not be obtained from the environment. *See* Pl. Exh. 6 at 7, 18, 51, C-10; Pl. Exh. 3 at ¶¶ 14-15. On the basis of this faulty assumption, Defendants arbitrarily and capriciously neglect to analyze any scenarios involving this type of terrorist threat or apply a bounding analysis to account for analytical uncertainty. *See* Pl. Exh. 6 at 62-63.

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[3] Defendants attempt to impugn the declaration of Dr. Mark Wheelis, an eminently qualified microbial biochemist and geneticist, by noting that his testimony was stricken in the prior litigation, even though his testimony in that case was subject to extra-record exceptions that are not applicable under these circumstances. *See* Def. Br. at 18. Moreover, Dr. Wheelis' declaration is primarily concerned with terrorism and risk, whereas his prior testimony largely concerned biological weapons and the Biological Weapons Convention.

[4] According to the new EA, research to be conducted in the proposed facility may include experiments with the Sterne and Vollum strains of anthrax. Def. Exh. 1 at C-9. The Vollum strain was chosen for weaponization by the U.S. offensive biological weapons program because of its lethality. Pl. Exh. 3 at ¶ 14.

Moreover, Defendants erroneously claim that the proposed BSL-3 "will not contain 'weaponized' or 'milled' biological agents," even though the new EA merely states that "LLNL would not have *large quantities* of 'milled' concentrated biological agents." Def. Br. at 13; Def. Exh. 6 at C-23 (emphasis added). Although Livermore Lab will not use the process of "milling," Defendants intend to perform screening analyses of threat biological agents gathered from air samples, which would likely have been "milled" to increase aerosolization. Def. Exh. 6 at C-23; Def. Exh. 10 at ¶ 3.

c. Covert theft and subsequent release of pathogenic material by an insider

Finally, with regard to the third type of threat, Defendants concede that, "[a]s shown [by the anthrax mailings] in 2001, dramatic human health impacts and economic disruption can result following the release of pathogenic materials" but fail to analyze even a single release scenario, let alone apply a bounding analysis to account for the analytical uncertainty Defendants themselves acknowledge. *See* Pl. Exh. 6 at 63-64.

In conclusion, instead of analyzing the potential consequences of a terrorist attack on the proposed facility, Defendants added a section to the original EA designed to demonstrate that Livermore Lab's security and containment systems are effective under optimal conditions. *See id.* at 57-64. In direct contravention of the Ninth Circuit's remand, there is no meaningful analysis of the environmental impacts of a successful terrorist attack. Accordingly, there is no question that Defendants failed to "take a 'hard look' at the environmental consequences before taking [the proposed] action." *Balt. Gas & Elec. Co. v. NRDC*, 462 U.S. 87, 97, 103 S. Ct. 2246 (1983) (quoting *Kleppe v. Sierra Club*, 427 U.S. 390, 410, n. 21, 96 S. Ct. 2718 (1976)).

ii. Failure to prepare an EIS

Despite Defendants' assertions to the contrary, Plaintiffs are likely to prevail on the merits of their claim that Defendants violated NEPA by failing to prepare an EIS for the proposed BSL-3 facility at Livermore Lab. If substantial questions are raised as to whether a project may cause significant degradation of some human environmental factor, an EIS must be prepared. *Klamath Siskiyou Wildlands Ctr. v. Boody*, 468 F.3d 549, 562 (9th Cir. 2006) (quoting

Idaho Sporting Cong. v. Thomas, 137 F.3d 1146, 1149 (9th Cir. 1998)). Under this "low standard," a plaintiff need not show that significant effects will in fact occur; merely raising substantial questions whether a project may have a significant effect is sufficient to require the preparation of an EIS. *Klamath Siskiyou Wildlands Ctr.*, 468 F.3d at 562 (quoting *Idaho Sporting Cong.*, 137 F.3d at 1150 (9th Cir. 1998)). Plaintiffs have met this burden.

a. Operation of the proposed facility may affect public health and safety

Defendants themselves acknowledge that, "[d]epending on the time of day and the type of research underway, a loss of containment [following a terrorist attack on the proposed facility] could result in a release of pathogenic materials." Pl. Exh. 6 at 59. As noted, Defendants also recognize that "dramatic human health impacts" can result from such a release. *Id.* at 64. Since the proposed facility is located in the middle of an approximately 1.3 square mile campus where nearly 8,000 individuals are employed, and where the nearest member of the public is about one-half mile away, it is clear that there are substantial questions as to whether operation of the proposed facility may affect public health and safety. *Id.* at 2, 55. Defendants, in their haste to begin operating the proposed facility, failed to analyze the impacts of a terrorist attack on public health and safety, which necessitate the preparation of an EIS.

Of note, on April 2, 1979, anthrax was released from a military microbiology facility at Sverdlovsk, in the former Soviet Union. Pl. Exh. 3 at ¶¶ 7-8. This incident, which appears to have been caused by operator error in removing and not replacing a HEPA filter, resulted in over 100 fatalities. *Id.* at ¶ 8. The wind speed at the time of the Sverdlovsk anthrax release was within the normal range for the Livermore Valley, where the proposed BSL-3 facility is located. *See* Pl. Exh. 19 at 4.7-4, 4.7-7; Pl. Exh. 20 at 1206-07. Thus, a release from the proposed facility, whether caused by terrorist attack or accident, could result in similar impacts to public health and safety.

b. The possible effects on the human environment are highly controversial

Again, Defendants attempt to prejudice this Court's consideration of the merits of this claim by arguing that it "was considered and rejected in Plaintiffs' prior challenge to the EA." Def. Br. at 17. However, Plaintiffs' claim is founded, in large part, on substantial disputes regarding the consequences of a deliberate release of pathogenic material from the proposed BSL-3 facility at Livermore Lab. *See* Pl. Br. at 20. Thus, there is no basis for dismissing this claim on the basis of any alleged preclusion resulting from the earlier litigation.

c. The possible effects on the human environment are highly uncertain and involve unique or unknown risks

Defendants seem to fundamentally misunderstand the import of the Ninth Circuit's ruling in the prior litigation and *San Luis Obispo Mothers for Peace v. NRC*, 449 F.3d 1016 (9th Cir. 2006), *cert. denied*, 127 S. Ct. 1124 (2007). In both cases, despite a lack of historical evidence of such attacks against the facilities in question, the Ninth Circuit rejected the argument that "the possibility of terrorist attack is so 'remote and highly speculative' as to be beyond NEPA's requirements." *Id.* at 1031; *see Tri-Valley Cares*, No. 04-17232, mem. op. at 4. What the Ninth Circuit recognized and Defendants fail to grasp is that preparation of an EIS "is mandated where uncertainty may be resolved by further collection of data," or "where the collection of such data may prevent 'speculation on potential . . . effects. The purpose of an EIS is to obviate the need for speculation by insuring that available data are gathered and analyzed prior to the implementation of the proposed action.'" *National Parks & Conservation Ass'n*, 241 F.3d at 732 (citing *Blue Mts. Biodiversity Project v. Blackwood*, 161 F.3d 1208, 1213-14 (9th Cir. 1998); quoting *Sierra Club v. United States Forest Service*, 843 F.2d 1190, 1194 (9th Cir. 1988)).

Here, preparation of an adequate EIS for the proposed BSL-3 facility at Livermore Lab would resolve any uncertainty regarding the possible effects on the human environment from operation of the facility. For instance, an adequate EIS for the proposed facility would thoroughly analyze the consequences of the theft and subsequent release of pathogenic material, which Defendants have not done, despite the potentially "catastrophic implications" of such an incident. *See* Pl. Exh. 6 at 62-65. In addition, an adequate EIS would thoroughly analyze impacts to uninvolved workers at Livermore Lab, the City of Livermore, and the San Francisco

Bay Area as the result of a release of pathogenic material following a terrorist attack, which Defendants also have not done. *See* 57-64.

iii. Failure to supplement

Plaintiffs are also likely to prevail on the merits of their claim that Defendants violated applicable regulations implementing NEPA by failing to prepare a supplement to the new EA in response to significant new circumstances and information relevant to the environmental impacts of the proposed facility that became publicly available only after the new EA was circulated for public review and comment. Supplementation is required where the proposed action will have a significant impact on the human environment in a manner not previously considered and evaluated. *Westlands Water Dist. v. United States DOI*, 376 F.3d 853, 873 (9th Cir. 2004) (quoting *South Trenton Residents Against 29 v. FHA*, 176 F.3d 658, 663 (3d Cir. 1999)).

a. The Livermore Lab anthrax release

Once again, Defendants have mischaracterized the substance of Plaintiffs' claim relating to the Livermore Lab anthrax release. *See* Def. Br. at 19. Then, once this straw man has been created, Defendants argue that Plaintiffs' claim fails because "NEPA does not require that EAs be circulated for public comment . . . ." *Id.* Here, Defendants have plainly misstated the holding of a recent Ninth Circuit decision, in which the court adopted the rule that "[a]n agency, when preparing an EA, must provide the public with sufficient environmental information, considered in the totality of circumstances, to permit members of the public to weigh in with their views and thus inform the agency decision-making process." *Bering Strait Citizens for Responsible Res. Dev. v. U.S. Army Corps of Eng'rs*, 511 F.3d 1011, 1026 (9th Cir. 2008).

As Plaintiffs have already noted, the description of the LLNL anthrax release in the draft version of the new EA omitted important details and downplayed the significance of the incident. Among other important gaps, that description failed to mention that anthrax was involved, that five individuals were exposed, that the anthrax was packaged by an unauthorized individual, or that Livermore Lab's Responsible Official failed to ensure compliance with the select agent regulations. *See* Pl. Exh. 4 at 57. Since these and other important details were included in the description of the incident in the final version of the new EA, Defendants apparently concede the

significance of this information. Pl. Exh. 6 at 56-57; *see* Def. Br. at 19. Under these circumstances, it cannot be said that Defendants provided the public with sufficient environmental information to permit members of the public to weigh in with their views. To the contrary, Defendants withheld significant information until after the public review and comment period on the draft version of the new EA had ended in order to circumvent public review and comment.[5]

b. Information regarding the safety and security of BSL-3 facilities

The Associated Press report concerning the safety and security of BSL-3 facilities constitutes significant new information relevant to the environmental impacts of the proposed facility. Defendants claim that "it is improbable laboratory staff would acquire an accidental laboratory-acquired infection during the operation of the proposed BSL-3," which has an estimated operational design life of at least 30 years. Pl. Exh. 6 at ii, 51. This report, which catalogues an impressive variety of mishaps at BSL-3 facilities throughout the country, renders this conclusion arbitrary and capricious.[6] In addition, this report undermines any suggestion that the operational history of BSL-3 facilities in the United States supports a finding that the proposed facility will not affect public health or safety. *See* Def. Br. at 17, 21.

c. Information concerning the proliferation of high-containment biosafety laboratories

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[5] Thus, this case bears no relation to *Biodiversity Conservation Alliance v. U.S. BLM*, in which there was no indication that the Bureau of Land Management had deliberately withheld information from the public regarding the environmental impacts of the proposed action. *See* 404 F.Supp.2d 212, 220 (D.D.C. 2005).

[6] The list of incidents proffered in the declaration of Edward Hammond is based almost exclusively on information obtained from public records act requests. *See* Pl. Exh. 1 at ¶ 20. Because this process is a lengthy one and any records obtained must be subjected to detailed analysis, this information was not available to Mr. Hammond during the public comment period for the new EA. As such, Plaintiffs have not forfeited any objections to Defendants' compliance with NEPA on the basis of this information. *See Dep't of Transp. v. Public Citizen*, 541 U.S. 752, 764-65, 124 S. Ct. 2204 (2004).

Information concerning the proliferation of high-containment biosafety laboratories, which was revealed in both the Government Accountability Office ("GAO") report and the hearing in Congress on October 4, 2007, is relevant to the environmental impacts of the proposed facility and requires supplementation of the new EA. *See* Pl. Exh. 17; Exh. 9. Above and beyond any questions regarding the alleged need for the proposed facility, Plaintiffs also noted that this information raises substantial questions about the safety and security of these facilities. Pl. Br. at 27-28.

A federal official who testified at the hearing in Congress noted that that are too many labs for the level of "fragmented, decentralized oversight that there is now." Pl. Exh. 11. At the hearing, Dr. Richard E. Besser, director of the Center for Disease Control and Prevention's Coordinating Office of Terrorism Preparedness and Emergency Response, "acknowledged that lab oversight could be improved," and stated that "it was 'critically important' for the government to begin convening a task force to suggest better ways to watch over the now-sprawling biodefense program." *Id.* Since Defendants repeatedly attempt to bolster their assertion that the proposed facility will not have a significant impact on the human environment based on the "stringent set of guidelines and regulations" under which BSL-3 facilities must operate, *see, e.g.,* Def. Br. at 3-4, the fact that a federal official charged with ensuring such oversight admits to its inadequacies provides "a *seriously* different picture of the environmental landscape such that another hard look is necessary." *Wisconsin v. Weinberger*, 745 F.2d 412, 418 (7th Cir. 1984) (emphasis in original).

iv. Failure to comply with applicable regulations

Plaintiffs are likely to prevail on the merits of their claim that Defendants violated applicable regulations implementing NEPA by issuing a FONSI for the proposed LLNL BSL-3 facility without public review and comment. The proposed action is without precedent whether that determination is based on the environmental impact of the proposed facility or the fact that DOE had not previously operated any microbiological facilities above Biosafety Level 2 ("BSL-2"). *See Alliance to Protect Nantucket Sound, Inc. v. U.S. Dep't of Army*, 398 F.3d 105, 115 (1st Cir. 2005); Pl. Ex. 6 at iii. Here, as specified above, the proposed BSL-3 facility at Livermore

Lab may cause unprecedented environmental impacts if a terrorist attack results in a release of pathogenic material. *See* Pl. Exh. 3 at ¶¶ 15-17. These impacts are magnified by the fact that the proposed facility—unlike most other civilian and medical biosafety facilities—will receive and produce genetically modified agents and aerosolize select agents for rodent testing, thereby increasing the risks of accidental occupational exposure and, in the case of a failure of containment, exposure of civilians outside the facility. Pl. Exh. 3 at ¶ 6, 10, 15. Thus, there is no merit in Defendants' assertion that "there is no difference between the environmental impacts of the LLNL BSL-3 facility" and the other BSL-3 facilities nationwide. Def. Br. at 23. As such, Defendants violated applicable regulations by issuing a FONSI for the proposed facility without public review and comment.

B. The balance of hardships tips sharply toward Plaintiffs

Because the significant threat to the human environment posed by operation of the proposed BSL-3 facility under these circumstances far outweighs the resulting negligible delay in operations that a preliminary injunction would occasion, the balance of hardships tips sharply in Plaintiffs' favor. Moreover, Plaintiffs have demonstrated the possibility of irreparable injury, and a preliminary injunction will advance the public interest.

i. Plaintiffs have demonstrated the possibility of irreparable injury

Plaintiffs only have "the burden of demonstrating 'the possibility of irreparable injury,' . . . not that irreparable injury 'will' necessarily occur." *NRDC v. Winter*, 2008 U.S. App. LEXIS 4504, at *111 (9th Cir. 2008) (citing *Freecycle Network, Inc. v. Oey*, 505 F.3d 898, 902 (9th Cir. 2007); *Earth Island Inst. v. U.S. Forest Serv.*, 442 F.3d 1147, 1159 (9th Cir. 2006)). According to Defendants, if a successful terrorist attack on the proposed facility resulted in the release of bioagents, "the effects of such a release would be localized in time (hours immediately following the terrorist act) and place (downwind from the BSL-3 facility)." Pl. Exh. 6 at 60. Since the proposed facility is located in close proximity to thousands of uninvolved workers and the nearest member of the public is about one-half mile away, a release of pathogenic material will likely result in irreparable injury in the form of deaths or injuries. *Id.* at ii, 55. Defendants

themselves acknowledge the existence of numerous terrorist attack scenarios that could result in a release of pathogenic material. *See id.* at 57-64. Thus, Plaintiffs have satisfied their burden.

ii. A preliminary injunction will advance the public interest

A preliminary injunction will advance the public interest because "[t]he preservation of our environment, as required by NEPA . . . , is clearly in the public interest." *Earth Island Inst.*, 442 F.3d at 1177. In the instant case, there is a strong public interest in ensuring that the environmental impacts of the proposed BSL-3 facility are thoroughly analyzed and proper mitigation measures are put into place. This interest, which here is principally considered with the threat of terrorism at the proposed facility, could not be overstated. By downplaying the terrorist threat and relying on an inapplicable bounding analysis, Defendants have not only violated the law but also endangered the health and safety of an untold number of individuals.

Defendants claim that "halting operations at the [proposed LLNL BSL-3] facility would directly and adversely impact national security," despite the fact that the declarations used to support this assertion contain far more equivocal language. *See, e.g.,* Def. Exh. 10 at ¶ 4 ("there is the *potential* to significantly delay the scientific scrutiny of the identified agent that *could* impact response and mitigation to a bioterrorism event") (emphasis added); Def. Exh. 11 at ¶ 4 ("on demand surge capability *may* be needed for operational bioforensics applications ") (emphasis added). Moreover, this Court's "deference is not absolute, even when a government agency claims a national security interest." *NRDC*, 2008 U.S. App. LEXIS 4504, at *119 (citing *Campbell v. U.S. Dep't of Justice*, 164 F.3d 20, 30 (D.C. Cir. 1998)).

Defendants claim that a preliminary injunction will harm Livermore Lab's biological security program by forcing the withdrawal of funding proposals, potentially resulting in a loss of jobs and impacts to LLNL's ability to retain and recruit staff. Def. Br. at 25. However, if Defendants began operating the facility in violation of NEPA, they should not be able to use this injudicious course of action to justify the denial of Plaintiffs' motion for preliminary injunction. If this were so, agencies would always be able to avoid injunctive relief by commencing a project in violation of NEPA and then claiming that an interruption in the project would threaten

it. Moreover, if the comparison is between a potential loss of jobs and a potential loss of human life, then the balance of harms clearly tips sharply toward Plaintiffs.

IV. CONCLUSION

For the reasons set forth above, Plaintiffs' motion for a preliminary injunction barring continued operation of the proposed BSL-3 facility at Livermore Lab should be granted.

Dated this 2nd day of April, 2008

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EXHIBIT 18

Plaintiffs' Reply to Defendants' Opposition to Plaintiffs' Motion for Preliminary Injunction

Atlanta Journal-Constitution, The (GA)

July 20, 2007
Section: News
Edition: First Replate; The Atlanta Journal-Constitution
Page: A1

Outage exposes flaws at CDC lab

World's deadliest germs are kept **at** DeKalb facility, but security may not be as foolproof as believed, judging from failure of backup generator.

ALISON YOUNG

Staff

A federal infectious disease laboratory in DeKalb County is supposed to be a crown jewel in the nation's defense against bioterrorism and other killer diseases.

But an hourlong power outage at the building last month, and the failure of a backup generator system, have raised questions about safety at the facility run by the Centers for Disease Control and Prevention.

The incident also renews concerns about security and regulation of similar high-containment labs being built across the nation to work with the world's deadliest germs, several experts said.

"This is an astonishing design lapse," said Richard Ebright, a molecular biologist on Rutgers University's biosafety committee. "It's just remarkable that a building of such national prominence, intended for work with some of the most lethal agents, was designed and constructed without an effective backup power system."

The outage shut down air pressure systems designed to contain deadly germs for about 60 minutes. No injuries were reported.

Ebright said CDC should close the lab building until the problem is fixed.

CDC and other experts disagreed. They said the high-containment labs have many layered safety systems that protect scientists and the public even if power fails.

CDC has declined to disclose what experiments were under way when lightning knocked out power June 15. The building's highest-risk labs have not yet opened, but others in use there are of a type that have worked with the 1918 pandemic flu strain, avian influenza and anthrax.

CDC is investigating what caused both electrical breakers to trip in the building, cutting off power without triggering backup generators. Even if the generators had started, the tripped breakers would have blocked power to the $214 million building.

The agency hopes to have the underlying problem diagnosed and fixed soon.

"I don't think there is anything we'll ever be able to do to totally prevent power outages at CDC," said agency spokesman Tom Skinner. "What we have to do is move toward minimizing the duration of the time we are without power."

The University of Georgia is a finalist to host a new anti-terrorism lab. Fears about lab accidents have prompted some communities to oppose construction of such labs and call for better regulation.

Safety concerns

Labs at CDC and elsewhere are designed with four levels of security and safety equipment. The most dangerous work occurs in Biosafety Level 3 and 4 labs.

The new CDC building has a suite of six Biosafety Level 4 labs, designed to contain the likes of Ebola and smallpox, that will begin operations this year. About 500 CDC scientists and staff work in the building's other labs.

When the power went out, a battery-operated system made sure doors and lights operated for 15 to 20 minutes, allowing scientists to shut down experiments safely, said Jon Crane, the building's principal architect.

The generators run special negative air pressure systems, in lab rooms and work cabinets, that help trap high-risk germs. When power was lost, air stopped flowing inward -- but it didn't rush out, said Dr. Casey Chosewood, CDC's health and safety officer.

Ebright, the Rutgers professor, said the loss of the pressurized air containment posed a risk. "In those cases, there could be potential exposure of the individuals carrying out the experiments," he said.

Beyond safety issues, Jeanne Guillemin, a senior fellow with the Massachusetts Institute of Technology's Security Studies Program, noted: "All your security that's relying on power just went down. It's not good."

Skinner declined comment on what happened to the building's security, but said CDC's external perimeter security remained intact during the outage.

Ebright, Guillemin and other experts questioned why the design of the building didn't effectively anticipate a lightning strike.

Regulations

CDC largely regulates itself when it comes to its high-containment labs, inspecting the facilities with help from the U.S. Department of Agriculture.

The National Institutes of Health and CDC also publish guidelines for building and running high-containment labs. Following the guidelines is generally a requirement for government funding.

Deborah Wilson, co-editor of the guidelines, said the outage posed no risk.

"Does it give me heartburn? I wouldn't want it to happen in one of my buildings," she said. But outages happen in all labs, she said, adding: "None of this makes me even raise an eyebrow."

In Boston, local regulations require disclosure of the details of lab incidents to city officials and residents.

Last year, Boston became the first U.S. city to regulate BSL-3 and BSL-4 labs. The move was prompted by concern about a BSL-4 lab being built at Boston University, and about tularemia infections among three lab workers that were not promptly reported to local officials.

The city's regulations require all BSL-3 and 4 labs to apply for permits, disclose the nature of their research and undergo regular inspections by the Boston Public Health Commission.

"It's a mechanism to oversee what they're doing," said Tony Gemmellaro, the health commission's director of biological safety.

In Boston, a power outage or any other incident must be reported to the commission within 24 hours. "So we would find out right away and do a follow-up inspection," Gemmellaro said.

Atlanta and DeKalb County officials said they have no authority to inspect CDC's buildings.

The Atlanta Journal-Constitution has requested documents about the power outage and other safety issues at CDC. The agency has declined to expedite their release, as allowed under federal law, saying "there is no urgency to inform the public."

The occasional lab accident usually only endangers a single scientist. Sometimes, however, a disease can spread outside the lab. In 2004, several cases of SARS were linked to a scientist who was exposed to the virus in a Chinese lab.

CDC labs appear to have a good safety record, said Ed Hammond, U.S. director of the Sunshine Project, an international biodefense watchdog group that monitors labs across the country.

"I'm unaware of them ever infecting anyone in Atlanta. That doesn't mean they couldn't," Hammond said. "With the Level 4 agents like CDC is handling, it's a low-probability event, but it's one of high consequences."

There were 38 incidents from January 2006 through June 2007 in which a CDC employee was potentially exposed to an infectious agent, said Skinner, the CDC spokesman.

Last fall, an accrediting organization placed CDC's animal laboratories on probation, citing serious and recurring issues in the agency's older BSL-3 and BSL-4 labs, among other things. The accreditation was restored in February.

To reach staff writer Alison Young, call 404-526-7372.

SAFETY FEATURES

Scientists at the Centers for Disease Control and Prevention use four types of laboratories with different levels of safety protection. Last month, a power outage shut down negative air pressure systems used to contain germs within biosafety work cabinets and within Level 3 and 4 lab rooms there. Here are the safety features of those labs:

Biosafety Level 4

Used for: Serious or lethal diseases, generally transmitted through inhalation, for which there is no vaccine or treatment; also for specific experiments that need greater risk protection. Agents may include Ebola virus, and other hemorrhagic fever viruses, smallpox and avian influenza.

Protections include:

• Series of connecting room with high-tech seals similar to submarine doors

• Lab located in separate building or isolated zone

• Clothing changed before entering lab

• Scientist showers before exiting lab

• All procedures conducted inside high-protection biosafety work cabinets

• Use of full-body air-supplied personnel protection suit

• Negative airflow within room to keep agents in lab

• High-efficiency filtration of contaminated air

• All BSL-3 protections

Biosafety Level 3

Used for: Agents that can cause serious or lethal diseases if inhaled, or experiments that create aerosols. They may include the 1918 pandemic influenza strain, anthrax, Rift Valley fever, drug-resistant tuberculosis, West Nile virus and animal experiments involving the SARS coronavirus.

Protections include:

• Controlled lab access

• Decontamination of all lab waste and clothing

• Biosafety cabinet used for manipulation of agents

• Negative airflow in room to keep germs in lab

• High-efficiency filtration of contaminated air

Sources: Centers for Disease Control and Prevention, National Institutes of Health
<ImageData>

Graphic

JEMAL R. BRINSON / Staff

Biosafety cabinet

This work bench is designed with special filtration systems and negative air pressure to contain materials that might spill or spray.

How it works

1. Fans pull in room air.

2. Air is drawn into the cabinet -- and away from the scientists -- to keep contaminated particles inside.

3. Air in cabinet is filtered to remove contaminants.

includes numbered illustration

</ImageData>

EXHIBIT 19

Plaintiffs' Reply to Defendants' Opposition to Plaintiffs' Motion for Preliminary Injunction

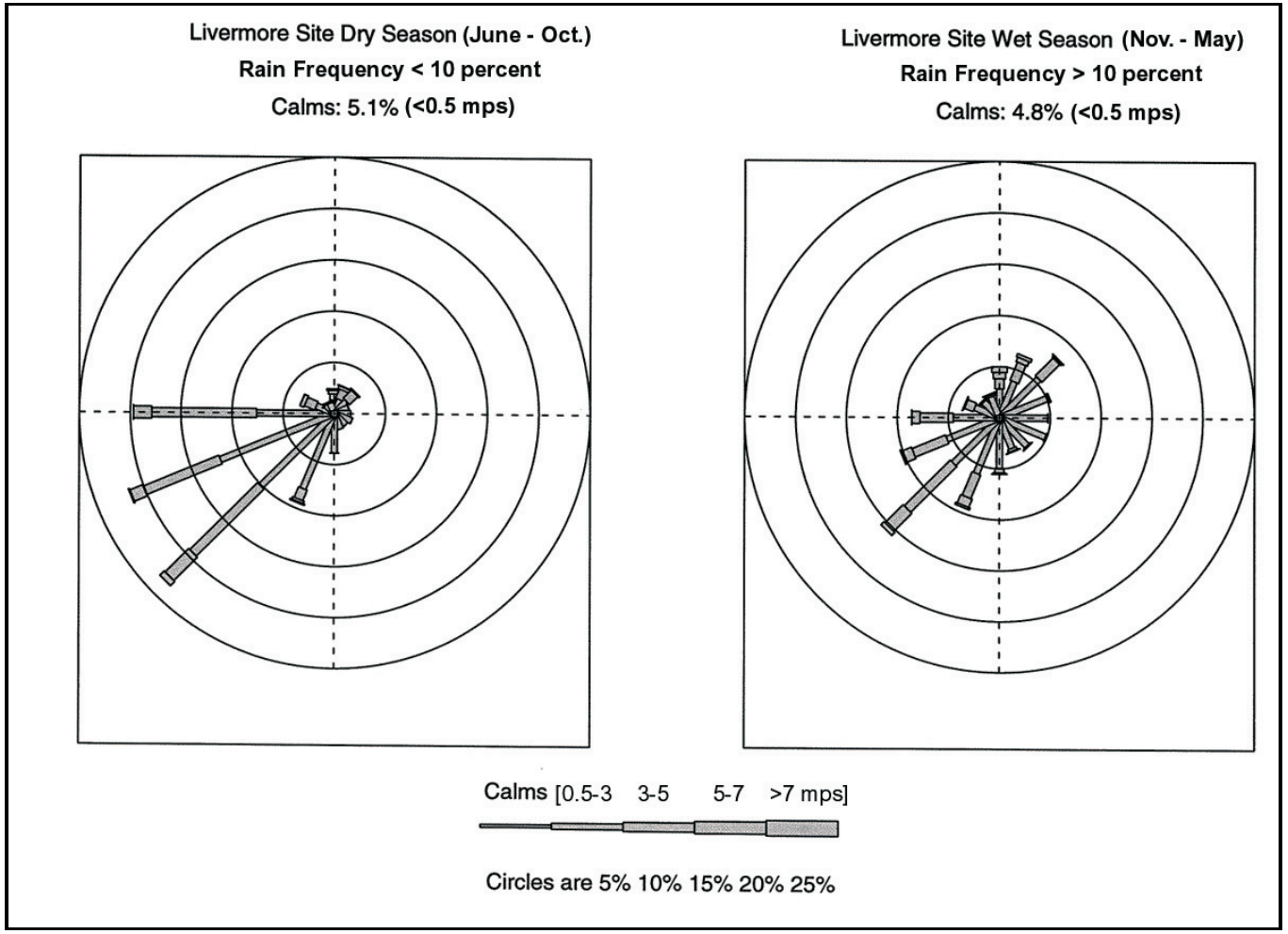
DOE/EIS-0348
DOE/EIS-0236-S3

Final Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement

March 2005

Volume I
Chapters 1 through 12

Prepared by:



Source: LLNL 2002bx.

Notes: Data from monitoring stations located at Livermore and Site 300.
The absolute length of each directional "telescope," in relation to the percent frequency radials, indicate the frequency of occurrence of each wind direction (direction from which the wind is blowing). Each of the directional telescopes is further segmented to indicate the frequency of individual wind speed classes. Each directional telescope consists of up to four segments relating to wind speed categories, with wider segments corresponding to increasingly higher wind speeds. The relative lengths of individual "telescope segments" are used to infer the frequency of occurrence of wind speed classes for each of the 16 compass wind directions.
One meter per second (mps) equals 2.2 miles per hour.

FIGURE 4.7.3–1.—*Seasonal Wind Roses for the Livermore Site (1997 – 2001)*

TABLE 4.7.4–1.—*Regional Storm Events (continued)*

Additional Storm Events with Unspecified or County-wide Locations			
County	**No. of Events**	**Event Type**	**Comments**
Alameda	1	Heavy snow	
Alameda	5	Winter storm, high winds	
San Joaquin	1	Winter storm	
San Joaquin	4	Extreme cold	

Source: NCDC 2002b.

[a] The NCDC Storm Event database, http://www.ncdc.noaa.gov/oa/climate/linktoed.html, contains data from the following sources: all weather events from 1993, as entered into storm data, plus additional data from the Storm Prediction Center, including tornadoes 1950 – 1992, thunderstorm winds 1955 – 1992, and hail 1955 – 1992. The events listed above include all reported events in the local areas, from January 1, 1950 through February 28, 2003, as available on the website accessed July 6, 2003.

LLNL = Lawrence Livermore National Laboratory; mph = miles per hour; NCDC = National Climatic Data Center.

4.7.5 Dispersion Meteorology and Atmospheric Pollution Potential

A combination of topographic and climatologic factors affects the atmosphere's ability to mix and disperse air pollutants. This ability is limited under certain conditions. The Bay Area Air Quality Management District (BAAQMD) has evaluated past high air pollutant episodes and determined the mix of conditions most conducive to pollutant buildup in the air basin. By looking for these conditions, BAAQMD is able to predict periodic episodes, and preemptive actions are taken to limit pollutant loading during such periods. The primary atmospheric processes that tend to concentrate pollutants are discussed below. Air pollutants and potential health impacts are further discussed in Section 4.10.

Inversions and Pollutant Trapping

Inversions often form on clear, calm winter nights through radiation cooling of air in contact with the earth's cold surface. When cool air near the earth's surface is trapped by warmer air above, vertical mixing is limited and air contaminants are not effectively dispersed. In such cases, as more pollutants are emitted but not dispersed, the total loading (pollutant level per volume of air) is increased. Low wind speeds also limit dilution, and the Livermore Valley is characterized by a high frequency of light winds due to the sheltering effect of surrounding terrain. Light winds occur most frequently during nighttime and early morning hours of fall and winter, which further enhances the radiation inversion.

There are frequent winter dry periods lasting over a week. These are particularly conducive to concentrating pollutants emitted close to the ground, such as carbon monoxide from auto exhaust. In contrast, during winter rainy periods, inversions are weak or nonexistent, winds are often moderate, ventilation and vertical mixing are usually high, and consequently air pollution potential is very low.

Inversions can also form under high pressure, through compression warming of sinking air. These subsidence inversions occur most frequently during summer under the dominance of the Pacific Coast high-pressure cell. When the inversion is strong, the air beneath the inversion is decoupled from the larger scale system. Dilution is then limited, and locally high pollutant buildup can occur if stagnation is prolonged.

EXHIBIT 20

Plaintiffs' Reply to Defendants' Opposition to Plaintiffs' Motion for Preliminary Injunction

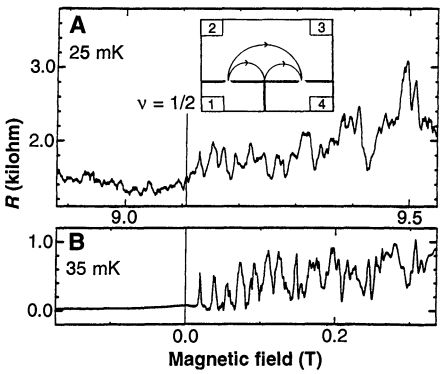


Fig. 4. The resistance $R = V_{34}/I_{21}$ for the magnetic focusing sample shown in the inset. (**A**) Focusing peaks of electrons near $B = 0$, and (**B**) focusing peaks of composite fermions near $B^* = 0$ (that is, near $\nu = 1/2$). The scales of B and B^* differ by a factor of about $\sqrt{2}$. A qualitative difference between the positive and negative B^* (that is, between $\nu > 1/2$ and $\nu < 1/2$) is evident, as is the one-to-one correspondence between several composite fermion and electron focusing peaks. [Reprinted from (*30*) with permission of Goldman *et al.*]

the lattice; some of the most relevant commensurate orbits are shown in the figure. Similar dimensional resonances of composite fermions show up near $B^* = 0$. Goldman *et al.* (*30*) observed magnetic focusing of composite fermions near $\nu = 1/2$. The experimental setup is shown in Fig. 4.; the current flows from 1 to 2, and the voltage is measured between 3 and 4. Near $B = 0$, a number of quasi-periodic peaks are observed (Fig. 4B), which occur at those values of B where the electrons coming straight out of the left constriction are focused into the right constriction, possibly after several specular reflections from the gate. Similar quasi-periodic structure was observed near $B^* = 0$ (Fig. 4A). The close correspondence between the electron and the composite fermion peaks is evident in both Figs. 3 and 4. These experiments confirm the existence of composite fermions in the compressible region near $\nu = 1/2$ by demonstrating that the dynamics of the charge carriers are described by the effective field B^* rather than the external field B. Thus, the composite fermion framework has not only provided a simple "one-step" explanation of the FQHE, it has also helped reveal the nontrivial nature of the metallic state at even-denominator fractions.

Conclusion

The following picture has finally emerged. First, electrons form LLs because of quantization of their kinetic energy. This results in the IQHE. Within the lowest LL, in a range of filling factor, electrons minimize their interaction energy by capturing vortices and transforming into composite fermions. Even though the composite fermions are quantum mechanical particles with a true many-body character, they may be treated, for most purposes, as ordinary noninteracting fermions moving in an effective magnetic field. They form quasi-LLs, execute cyclotron motion, and fill a Fermi sea. The formation of composite fermions lies at the root of the FQHE and several other fascinating experimental phenomena.

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32. Financial support from the National Science Foundation under grant DMR93-18739 is acknowledged.

The Sverdlovsk Anthrax Outbreak of 1979

Matthew Meselson,* Jeanne Guillemin, Martin Hugh-Jones, Alexander Langmuir,† Ilona Popova, Alexis Shelokov, Olga Yampolskaya

In April and May 1979, an unusual anthrax epidemic occurred in Sverdlovsk, Union of Soviet Socialist Republics. Soviet officials attributed it to consumption of contaminated meat. U.S. agencies attributed it to inhalation of spores accidentally released at a military microbiology facility in the city. Epidemiological data show that most victims worked or lived in a narrow zone extending from the military facility to the southern city limit. Farther south, livestock died of anthrax along the zone's extended axis. The zone paralleled the northerly wind that prevailed shortly before the outbreak. It is concluded that the escape of an aerosol of anthrax pathogen at the military facility caused the outbreak.

Anthrax is an acute disease that primarily affects domesticated and wild herbivores and is caused by the spore-forming bacterium *Bacillus anthracis*. Human anthrax results from cutaneous infection or, more rarely, from ingestion or inhalation of the pathogen from contaminated animal products (*1*). Anthrax has also caused concern as a possible agent of biological warfare (*2*).

Early in 1980, reports appeared in the Western press of an anthrax epidemic in Sverdlovsk, a city of 1.2 million people 1400 km east of Moscow (*3*, *4*). Later that year, articles in Soviet medical, veterinary, and legal journals reported an anthrax outbreak among livestock south of the city in the spring of 1979 and stated that people developed gastrointestinal anthrax after eating contaminated meat and cutaneous anthrax after contact with diseased animals (*5*–*7*). The epidemic has occasioned intense international debate and speculation as to whether it was natural or accidental and, if accidental, whether it resulted from activities prohibited by the Biological Weapons Convention of 1972 (*8*).

In 1986, one of the present authors (M.M.) renewed previously unsuccessful re-

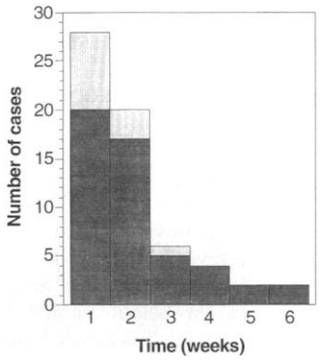

Fig. 1. Time course of the epidemic: onsets of fatal cases by week. The first week begins on 4 April 1979, the date of the first onset we recorded. Lighter shading represents cases for which the onset date is unknown and is estimated by subtracting 3 days from the date of death.

quests to Soviet officials to bring independent scientists to Sverdlovsk to investigate. This resulted in an invitation to come to Moscow for discussions with four physicians who had gone to Sverdlovsk to deal with the outbreak (including another of the present authors, O.Y., who was a clinician in the intensive care unit set aside to treat the victims). In 1988, two of these Soviet physicians visited the United States, where they gave formal presentations and participated in discussions with private and government specialists. According to their account, contaminated animals and meat from an epizootic south of the city starting in late March 1979 caused 96 cases of human anthrax with onsets from 4 April to 18 May. Of these cases, 79 were said to be gastrointestinal and 17 cutaneous, with 64 deaths among the former and none among the latter (9).

The impression left on those of the present authors who took part in the U.S. meetings (J.G., A.L., M.M., and A.S.) was that a plausible case had been made but that additional epidemiological and pathoanatomical evidence was needed. Further requests by M.M. for an invitation led to an on-site study in Sverdlovsk, initiated there in June 1992, and a return visit in August 1993.

Starting in 1990, several articles about the epidemic appeared in the Russian press (*10*). These included interviews with Sverdlovsk physicians who questioned the food-borne explanation of the epidemic and with officials at the military microbiology facility. These officials said that in 1979 they had been developing an improved vaccine against anthrax but knew of no escape of anthrax pathogen. Late in 1991, Russian President Boris Yeltsin, who in 1979 was the chief Communist Party official of the Sverdlovsk region, directed his Counsellor for Ecology and Health to determine the origin of the epidemic (*11*). In May 1992, Yeltsin was quoted as saying that "the KGB admitted that our military developments were the cause" (*12*). No further information was provided. Subsequently, the chairman of the committee created by Yeltsin to oversee biological and chemical disarmament expressed doubt that the infection originated at the military facility and stated that his committee would conduct its own investigation (*13*). The results of that investigation have not yet appeared.

Pathoanatomical evidence that the fatal cases were inhalatory, recently published by Russian pathologists who performed autopsies during the epidemic (*14–16*), is summarized in an earlier report from the present study (*17*). Here we report epidemiological findings that confirm that the pathogen was airborne, and we identify the location and date of its escape into the atmosphere.

Table 1. Case data. Case numbers for fatalities are as they appear on the administrative list. Case numbers for survivors are arbitrary. Days of onset and death are counted from 1 April 1979. Abbreviations: O, onset; D, death; R, residence; W, workplace; *, unidentified man; ?, not known; ma, mid-April; s, survivor; c, cutaneous survivor; +, in high-risk zone; −, outside high-risk zone; a, had two residences, one in Compound 32; p, pensioner; r, daytime military reservist at Compound 32; u, unemployed. Patients 25, 29, 48, and 87 were home on vacation during the first week of April.

Case no.	Age/sex	O/D	R/W	Case no.	Age/sex	O/D	R/W
*	?/m	?/?	?/?	51	31/m	10/15	−/?
32	40/m	?/?	−/?	40	37/m	12/15	+/+
67	26/m	?/?	+/+	36	68/f	?/16	a/p
68	32/f	?/?	+/+	35	52/m	13/16	+/+
8	60/f	?/8	+/+	34	43/m	14/16	−/+
18	38/m	6/8	−/?	38	69/f	14/16	+/p
16	40/m	?/9	+/+	39	49/m	14/16	+/+
66	55/f	?/9	−/?	41	41/f	?/17	+/p
1	44/m	6/9	+/+	42	43/m	15/18	−/+
2	46/m	6/9	+/+	43	39/m	15/19	+/u
5	66/m	7/9	−/+	44	47/m	15/21	−/?
49	51/m	8/9	+/+	45	45/m	?/22	+/+
21	49/m	?/10	−/?	46	39/m	20/23	−/+
4	54/f	5/10	+/+	47	41/m	21/24	−/−
6	40/m	7/10	−/?	52	42/m	21/24	−/−
20	39/m	7/10	−/−	53	47/m	22/24	−/−
17	67/f	8/10	+/+	48	57/f	15/25	+/−
9	72/f	9/10	+/p	54	50/f	17/25	−/?
7	52/f	?/11	+/+	55	31/m	23/25	+/+
19	64/f	?/11	−/?	57	31/m	27/28	−/r
22	27/m	?/11	+/+	58	32/m	29/30	−/+
23	43/m	?/11	−/r	59	55/m	27/31	−/+
3	48/f	4/11	−/+	60	33/m	25/33	−/r
10	27/m	9/11	+/−	61	42/m	34/40	−/+
65	72/m	9/11	+/p	62	29/m	39/40	+/+
15	48/f	6/12	+/+	63	25/m	37/42	−/+
25	46/m	10/12	−/−	64	28/m	42/46	−/?
12	38/m	11/12	−/+	90	28/m	?/s	−/+
11	27/m	12/12	−/r	82	68/f	13/s	+/+
26	67/m	9/13	+/p	80	49/m	14/c	+/−
13	24/f	10/13	+/+	84	55/f	ma/c	−/+
24	65/f	10/13	+/p	85	40/f	ma/s	+/+
28	47/m	11/13	+/+	89	50/f	34/s	+/−
14	49/m	12/13	−/+	86	28/m	37/s	−/−
27	64/m	10/14	+/+	81	29/m	38/s	+/+
31	42/m	11/14	−/r	83	45/m	41/s	+/+
30	52/m	12/14	+/+	87	41/m	42/s	+/−
29	45/m	13/14	+/+	88	37/m	45/s	+/+
50	72/f	?/15	+/p				

Sources of Information

Local medical officials told us that hospital and public health records of the epidemic had been confiscated by the KGB. We nevertheless were able to assemble detailed information on many patients from a variety of sources. (i) An administrative list giving names, birth years, and residence addresses of 68 people who died, compiled from KGB

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records and used by the Russian government to compensate families of the deceased (*18*). Comparison with other sources of information, including those listed below, indicates that the administrative list may include most or all of those who died of anthrax. (ii) Household interviews with relatives and friends of 43 people on the administrative list and with 9 survivors or their relatives (or both). The interviews (directed by J.G.) were designed to identify the workplaces and other whereabouts of patients before their illness. (iii) Grave markers, giving names and dates of birth and death, that we inspected in the cemetery sector set aside for the anthrax victims. These include 61 markers with names that are also on the administrative list and 5 with illegible or missing name plates. (iv) Pathologists' notes regarding 42 autopsies that resulted in a diagnosis of anthrax (*14–17*). All but 1 of the 42, an unidentified man, are on the administrative list. The notes include name, age, and dates of onset, admission, death, and autopsy. (v) Various hospital lists, with names, residence addresses, and, in some cases, workplaces or diagnoses (or both) of approximately 110 patients who were apparently screened for anthrax, 48 of whom are indicated to have died. Of the latter, 46 are on the administrative list. (vi) Full clinical case histories of 5 survivors hospitalized in May 1979.

Current street and regional maps were purchased in Sverdlovsk, which is known again by its prerevolutionary name of Ekaterinburg. The city is the seat of an administrative region, or *oblast*, named Sverdlovskaya. The city itself is divided among a number of districts, or *rayon*, the most southerly being Chkalovskiy *rayon*. A satellite photograph of the city taken 31 August 1988 was purchased from SPOT Image Corporation (Reston, Virginia). Archived meteorological data from the city's Koltsovo airport were obtained from the National Center for Atmospheric Research (Boulder, Colorado).

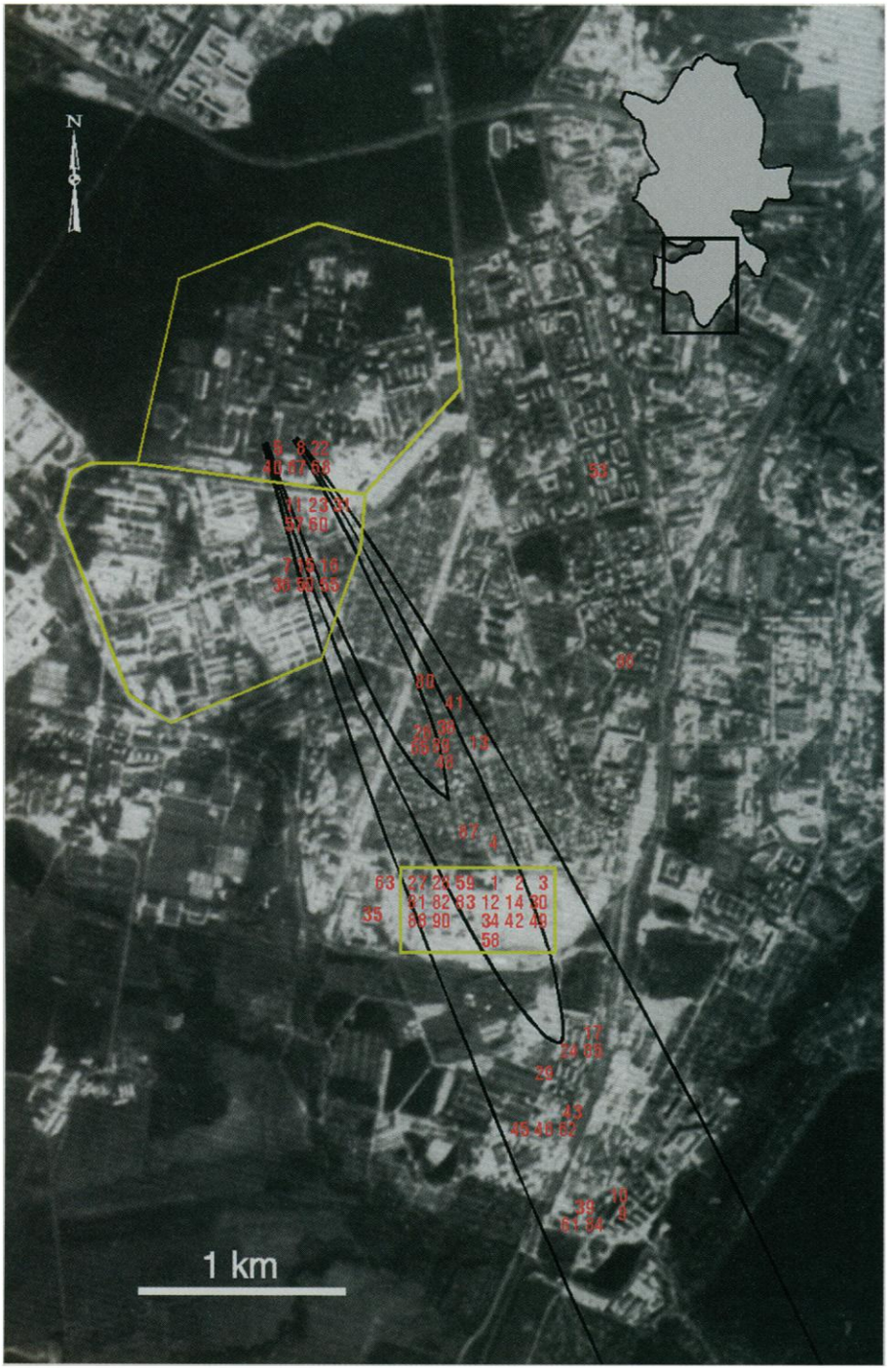

Fig. 2. Probable locations of patients when exposed. The part of the city shown in the photograph is enclosed by a rectangle in the inset. Case numbers, in red, correspond to those in Table 1 and indicate probable daytime locations of patients during the period 2 to 6 April 1979. Of the 66 patients mapped as explained in the text, 62 mapped in the area shown. This distribution may be somewhat biased against residence locations, because daytime workers not on vacation who both resided and worked in the high-risk zone are mapped at their workplaces. Proceeding from north to south, Compound 19, Compound 32, and the ceramics factory are outlined in yellow. The five patients residing in Compound 32 are mapped at their apartments. Within the compound, the placement of an additional, part-time resident and of the five reservists is arbitrary, as is that of the five residents and a nonresident employee in Compound 19. Patients known to have worked in the ceramics pipe shop are mapped in the eastern part of the factory area, where the pipe shop is located. Calculated contours of constant dosage are shown in black. Approximately 7000 people lived in the area bounded by the outermost contour of constant dosage, Compound 32, and the ceramics factory. The terrain slopes gently downward by about 40 m from Compound 19 to the ceramics factory.

Case Data

Table 1 presents information on 66 patients who died and 11 who survived. The fatalities include the unidentified man and all people named on the administrative list, except for three patients for whom recent reexamination of preserved autopsy specimens does not support a diagnosis of anthrax (*19*). For survivors, diagnoses of anthrax are supported by clinical case histories or hospital lists or both and by household interviews.

Overall, 55 of the 77 tabulated patients are men, whose mean age was 42. The mean

age for women was 55. No man was younger than 24, and only two women, aged 24 and 32, were under 40. Recorded onsets span a period of nearly 6 weeks, 4 April to 15 May, with a mean time between onset and death of 3 days (Table 1 and Fig. 1).

Approximately 60% of the 33 men for whom we have relevant information were described as moderate or heavy smokers and nearly half as moderate or heavy drinkers. None of the women was said to have smoked or to have consumed alcohol more than occasionally. Few patients were reported to have had serious preexisting medical conditions. Among the 35 men whose occupation in 1979 we could determine, the most common occupation was welder, accounting for 7.

In descending order of frequency, symptoms reported in household interviews included fever, dyspnea, cough, headache, vomiting, chills, weakness, abdominal pain, and chest pain. Two of the survivors interviewed reported having had cutaneous anthrax, one on the back of the neck, the other on the shoulder. Hospitalized patients were treated with penicillin, cephalosporin, chloramphenicol, anti-anthrax globulin, corticosteroids, osmoregulatory solutions, and artificial respiration. The average hospital stay was 1 to 2 days for fatal cases and approximately 3 weeks for survivors. To the best of our knowledge, no human anthrax has occurred in the Sverdlovsk region since 1979.

Public Health Response

Public health measures were initially directed by an emergency commission formed in Chkalovskiy *rayon*, where most patients lived and worked. On or about 10 April, overall direction was assumed by a commission that was constituted at *oblast* level and included the USSR Deputy Minister of Health. Military personnel participated little if at all in the implementation of medical and public health measures.

Before the bacteriological confirmation of anthrax, on 11 April (*14*), patients were taken to hospitals served by the ambulance or polyclinic of first contact. Starting on 12 April, most patients presenting with high fever or other indications of possible anthrax or who died at home or elsewhere of suspected anthrax were taken to city hospital No. 40, where separate areas were designated for screening suspect cases and for treating nonsystemic cutaneous cases, for intensive care, and for autopsy. Bodies of those who died were placed in coffins with chlorinated lime and buried in a single sector of a city cemetery. Medical and sanitation teams recruited from local hospitals and factories visited homes of suspected and confirmed cases throughout the city, where they conducted medical interviews, dispensed prophylactic tetracycline to patients' households, disinfected kitchens and sick rooms, and took meat and environmental samples for bacteriological testing. Human anthrax is not considered contagious, nor was there any evidence of person-to-person transmission. In the part of Chkalovskiy *rayon* where most patients resided, building exteriors and trees were washed by local fire brigades, stray dogs were shot by police, and several previously unpaved streets were asphalted. Newspaper articles and posters warned of the risk of anthrax from consumption of uninspected meat and contact with sick animals. Uninspected meat in vehicles entering the city from the south was confiscated and burned at highway checkpoints.

Starting in mid-April, a voluntary immunization program using a live nonencapsulated spore vaccine (designated STI) was carried out for healthy persons 18 to 55 years old served by clinics in Chkalovskiy *rayon*. Posters urged citizens to obtain "prophylactic immunization against anthrax" at designated times and places. Of the 59,000 people considered eligible, about 80% were vaccinated at least once.

Geographical Distribution of Human Cases

Most of the 77 tabulated patients lived and worked in the southern area of the city shown in Fig. 2. Of the 66 patients for whom we have both residence and workplace locations, 9 lived and regularly worked outside of this area. Interviews with relatives and friends revealed that five of these nine had attended military reserve classes during the first week of April 1979 at Compound 32, an army base in the affected area. Respondents stated and, in one case, showed diary notes establishing that the first day of attendance was Monday, 2 April, that classes began at 0830, and that participants returned home each evening. Assuming that the reservists were exposed while at or near Compound 32, this must have occurred during the daytime in the week of 2 April.

In order to locate the high-risk area more precisely, we prepared a map showing probable daytime locations of the 66 patients during the week of 2 April. Those with residence or work addresses in military compounds or attending reserve classes were placed in the appropriate military compound; night workers, pensioners, unemployed people, and vacationers were placed at their homes; and all other workers were placed at their workplaces. This mapped 57 patients in a narrow zone approximately 4 km long, extending from the military microbiology facility to the southern city limit. The remaining nine worked outside this zone, but three of them resided within it. Placing the latter at their residences gives the distribution shown in Fig. 2, with 60 of the 66 mapped cases in the

Fig. 3. Villages with animal anthrax. Six villages where livestock died of anthrax in April 1979 are A, Rudniy; B, Bolshoye Sedelnikovo; C, Maloye Sedelnikovo; D, Pervomaiskiy; E, Kashino; and F, Abramovo. Settled areas are shown in gray, roads in white, lakes in blue, and calculated contours of constant dosage in black.

high-risk zone, 2 cases east of it, and 4 cases north or east of the area of the figure. Of these six patients who both worked and lived outside the high-risk zone, three had occupations (truck driver, pipe layer, and telephone worker) that might have taken them there, one was temporarily working in Chkalovskiy *rayon*, one was on vacation, and inadequate information was available for another.

At the northern end of the high-risk zone is the military microbiology facility, Compound 19, followed to the south by Compound 32. Both compounds include numerous buildings, with four- and five-story apartment houses for about 5000 people at the former and 10,000 at the latter. The administrative list includes five people who lived in Compound 19 and five who lived in Compound 32. All of the latter resided in four adjacent apartment buildings in the eastern part of the compound. Interviews in Compound 32 indicated that all of its residents who died of anthrax are on the administrative list. Interviews were not conducted in Compound 19.

Adjacent to Compound 32 and extending south-southeast for about 1.5 km is a residential neighborhood with a 1979 population density of approximately 10,000 per square kilometer, composed of small single-story private houses and a few apartment houses, shops, and schools. Just south of this is a ceramics factory that had about 1500 daytime employees. Of the 18 tabulated patients who were employees there, 10 worked in a large unpartitioned building where ceramic pipe was made and which had a daytime work force of about 450. The attack rate at the ceramics factory therefore appears to be 1 to 2%. Still farther south are several smaller factories, apartment buildings, private houses, schools, and shops, beyond which begins open countryside with patches of woodland.

Animal Anthrax

Anthrax has been enzootic in Sverdlovskaya *oblast* since before the 1917 revolution (*20*). Local officials recalled an outbreak of anthrax among sheep and cattle south of the city in early spring 1979. A detailed report of a commission of veterinarians and local officials describes the epizootic in Abramovo, a village of approximately 100 houses 50 km south-southeast of Compound 19. The report, dated 25 April 1979, records the deaths or forced slaughter of seven sheep and a cow with anthrax that was confirmed by veterinary examination. The first such losses were of two sheep on 5 April, followed by two more on each of the next 2 days, another on 8 April, and a cow on 10 April, all belonging to different private owners. These losses were substantiated by interviews we conducted with owners of six of the sheep that died. Respondents said there had been no human anthrax in the village. During a livestock immunization program started on 10 April, 298 sheep were given anti-anthrax serum or vaccine or both. The attack rate among sheep at Abramovo therefore appears to have been approximately 2%.

In addition, we obtained veterinary reports of bacteriological tests positive for anthrax in samples from three sheep from three farms in the village of Kashino, one sheep from Pervomaisky, and a cow from Rudniy, the earliest samples being received for testing on 6 April. Although other documents cite the forced slaughter of a sheep in Rudniy on 28 March and the death of another in Abramovo on 3 April, the earliest livestock losses for which we have documentation of a diagnosis of anthrax are those in Abramovo on 5 April.

Altogether, Soviet publications (*6*, *7*) and the documents we obtained cite outbreaks of anthrax among livestock in six villages: Rudniy, Bolshoye Sedelnikovo, Maloye Sedelnikovo, Pervomaiskiy, Kashino, and Abramovo. All six villages lie along the extended axis of the high-risk zone of human anthrax (Fig. 3). The centerline of human and livestock cases has a compass bearing of 330° ± 10°.

Meteorology

Surface (10 m) observations reported at 3-hour intervals from Koltsovo airport, 10 km east of the ceramics factory, were examined in order to identify times when the wind direction was parallel to the centerline of human and animal cases. During the time that the reservists who contracted anthrax were at Compound 32, but before the first recorded human onsets, this occurred only on Monday, 2 April, when northerly winds from the sector 320° to 350° were reported throughout the period 0400 to 1900 local time (Fig. 4).

During the rest of April, winds from this sector seldom occurred, accounting for fewer than 2% of reports. During the period of northerly wind on 2 April, which followed the passage of a cold front, the wind speed was 4 to 6 m s^{-1}, the temperature −10° to −3°C, the relative humidity 50 to 66%, the sky cloudless, and the midday sun 39° above the horizon. These conditions of insolation and wind speed indicate that the atmosphere near the surface was of neutral stability (*21*). As is consistent with this, temperature measurements at 500 to 1000 m indicated a slightly stable atmosphere at 0400 and 1000 hours, becoming neutral by 1600.

Discussion

We have presented evidence that (i) most people who contracted anthrax worked, lived, or attended daytime military reserve classes during the first week of April 1979 in a narrow zone, with its northern end in a military microbiology facility in the city and its other end near the city limit 4 km to the south; (ii) livestock died of anthrax in villages located along the extended axis of this same zone, out to a distance of 50 km; (iii) a northerly wind parallel to the high-risk zone prevailed during most of the day on Monday, 2 April, the first day that the military reservists who contracted anthrax were within the zone; and (iv) the first cases of human and animal anthrax appeared 2 to 3 days thereafter.

We conclude that the outbreak resulted from the windborne spread of an aerosol of anthrax pathogen, that the source was at the military microbiology facility, and that the escape of pathogen occurred during the day on Monday, 2 April. The epidemic is the largest documented outbreak of human inhalation anthrax.

The narrowness of the zone of human and animal anthrax and the infrequency of northerly winds parallel to the zone after 2 April suggest that most or all infections resulted from the escape of anthrax pathogen on that day. Owing to the inefficiency of aerosol deposition and resuspension (*22*, *23*), few if any inhalatory infections are likely to have resulted from secondary aerosols on subsequent days. A single date of inhalatory infection is also consistent with the steady decline of onsets of fatal cases in

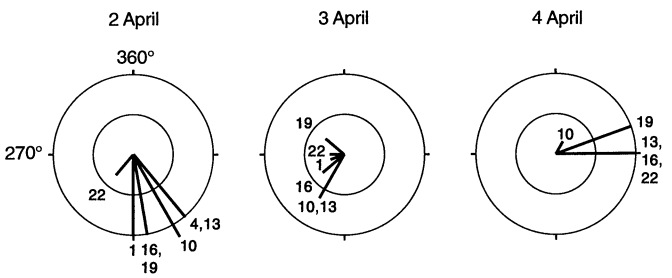

Fig. 4. Wind directions and speeds reported from Koltsovo airport for the period 2 to 4 April 1979. Numbers at the downwind end of each line are local standard times. Inner and outer concentric circles designate wind speeds of 2.5 and 5.0 m s^{-1}, respectively. Zero wind speed was reported for 0400 on 3 April and for 0100 and 0400 on 4 April. No data were reported for 0700.

successive weeks of the epidemic.

Accepting 2 April as the only date of inhalatory exposure, the longest incubation period for fatal cases was 43 days and the modal incubation period was 9 to 10 days. This is longer than the incubation period of 2 to 6 days that has been estimated from very limited data for humans (*24*). Experiments with nonhuman primates have shown, however, that anthrax spores can remain viable in the lungs for many weeks and that the average incubation period depends inversely on dose, with individual incubation periods ranging between 2 and approximately 90 days (*25, 26*).

The absence of inhalation anthrax patients younger than 24 remains unexplained. Although nothing suggests a lack of children or young adults in Chkalovskiy *rayon* in 1979, they may have been underrepresented in the aerosol plume. Alternatively, older people may have been more susceptible, which may also explain the lack of young people in epidemics of inhalation anthrax early in this century in Russian rural communities (*27*).

It may be asked if the geographical distribution of cases is consistent with the distribution expected for an aerosol of anthrax spores released at Compound 19 under the daytime atmospheric conditions of 2 April 1979. Contours of constant dosage were calculated from a Gaussian plume model of atmospheric dispersion, with standard deviations given by Briggs for neutral atmospheric stability in open country (*21*), a wind speed of 5 m s^{-1}, a nominal release height of 10 m, and no limit to vertical mixing (Figs. 2 and 3). The aerosol is assumed to consist of particles of diameter <5 μm, as can be produced, for example, by a laboratory aerosol generator (*28*), and to have a negligible infectivity decay rate (<0.001 min^{-1}) (*2*) and a deposition velocity <0.5 cm s^{-1}, which is insufficient to cause appreciable reduction of dosage at downwind distances less than 50 km (*29–31*). Dosage contours are not shown closer than 300 m to the putative source, as the dosage at shorter distances depends sensitively on the effective release height of the aerosol and the configuration of nearby buildings.

People indoors will be exposed to the same total dosage as those outside if filtration, deposition, and infectivity decay of the aerosol are negligible. The negligibility of these factors is supported by the absence of significant dosage reduction in field studies of protection afforded by tightly constructed buildings against an outside spore aerosol (*32*).

The calculated contours of constant dosage, like the zone of high human and animal risk, are long and narrow. Contours are shown at 10, 5, and 1 × 10^{-8} Q spore minutes per cubic meter (Fig. 2) and at 0.5, 0.2, and 0.1 × 10^{-8} Q spore minutes per cubic meter (Fig. 3), where Q is the number of spores released as aerosol at the source. The number of spores inhaled is the dosage multiplied by the breathing rate. On the innermost contour of Fig. 2, for example, a person breathing 0.03 m^3 min^{-1}, as for a man engaged in light work (*33*), would inhale 3 × 10^{-9} Q spores.

The calculated dosage at Abramovo is more than an order of magnitude lower than that at the ceramics factory. This suggests that sheep, reported to be more susceptible to inhalation anthrax than are monkeys (*34*), are also more susceptible than humans.

It has been suggested that if Compound 19 was the source, there would have been many more cases in its close vicinity than farther downwind (*13*). This expectation may be misleading, for as a cloud moves downwind it also widens. The total crosswind-integrated dosage will therefore decrease more slowly with distance than does the dosage along the centerline. In the present case, whereas the calculated centerline dosage decreases by a factor of 40 between 0.3 and 3 km downwind, the crosswind-integrated dosage decreases by a factor of only 4. Depending on the dose-response relation, the crosswind-integrated attack rate may decrease even more slowly than this. Considering, in addition, the lack of information regarding the exact locations of people in Compounds 19 and 32 at the time of exposure, the distribution of cases is not inconsistent with a source at Compound 19.

More detailed comparison of the geographical distribution of cases with the calculated distribution of dosage would require knowledge of the precise locations of individuals in relation to the plume, the number of spores released as aerosol, and the relation between dosage and response for the particular spore preparation, aerosol, and population at risk.

By far the largest reported study of the dose-response relation for inhalation anthrax in primates used 1236 cynomolgus monkeys exposed to an aerosol of the Vollum 1B strain of *B. anthracis* (*26, 35*). This provided data that, when fitted to a log-normal distribution of susceptibility to infection, gave a median lethal dose (LD_{50}) of 4100 spores and a slope of 0.7 probits per log dose (*26, 36*). This LD_{50} may be compared with an LD_{50} of 2500 spores obtained in an experiment done under identical conditions with 200 rhesus monkeys (*35*) and with a U.S. Defense Department estimate that the LD_{50} for humans is between 8000 and 10,000 spores (*8*). For a log-normal distribution with LD_{50} = 8000 and slope = 0.7, the dose causing 2% fatalities, as recorded at the ceramics pipe shop, approximately 2.8 km downwind of the source, is nine spores. According to the Gaussian plume model we have used, this dose would be inhaled by individuals breathing 0.03 m^3 min^{-1} at the pipe shop if the aerosol released at the source contained 4 × 10^9 spores. In contrast, a release 150 times larger is estimated if the calculation is based on an LD_{50} of 4.5 × 10^4 spores, which has been obtained for rhesus monkeys by other investigators (*37*), and if it is assumed that spores act independently in pathogenesis and that all individuals are equally susceptible (*38*). This estimate would be lowered if allowance were made for nonuniform susceptibility. If these divergent estimates bracket the actual value, the weight (*39*) of spores released as aerosol could have been as little as a few milligrams or as much as nearly a gram.

In sum, the narrow zone of human and animal anthrax cases extending downwind from Compound 19 shows that the outbreak resulted from an aerosol that originated there. It remains to be learned what activities were being conducted at the compound and what caused the release of the pathogen.

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RESEARCH ARTICLE

Analysis and Expression of a Cloned Pre–T Cell Receptor Gene

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The T cell antigen receptor (TCR) β chain regulates early T cell development in the absence of the TCRα chain. The developmentally controlled gene described here encodes the pre-TCRα (pTα) chain, which covalently associates with TCRβ and with the CD3 proteins forms a pre-TCR complex that transduces signals in immature thymocytes. Unlike the λ5 pre–B cell receptor protein, the pTα chain is a type I transmembrane protein whose cytoplasmic tail contains two potential phosphorylation sites and a Src homology 3 (SH3)–domain binding sequence. Pre-TCRα transfection experiments indicated that surface expression of the pre-TCR is controlled by additional developmentally regulated proteins. Identification of the pTα gene represents an essential step in the structure-function analysis of the pre-TCR complex.

T cell development takes place in discrete steps during which the TCR genes are rearranged and expressed in temporal order. During development of TCRαβ-expressing cells the TCRβ gene is rearranged and expressed before the TCRα gene (*1*, *2*). Without TCR rearrangement the development of T cells is arrested at an early stage (*3*–*5*). By introducing TCRβ transgenes into mice that are defective for rearrangement of antigen receptor genes, it was shown that TCRβ proteins, in the absence of TCRα chains, are sufficient to promote early T cell development (*6*–*8*). Although such mice are still rearrangement-defective, their immature thymocytes (which express neither the CD4 nor CD8 proteins) begin to express CD4 and CD8 coreceptors, transcripts of the TCRα locus become detectable (*7*), and the number of thymocytes increases (*6*–*8*). Introduction of TCRβ transgenes into normal mice suppresses rearrangement of endogenous TCRβ genes (*9*, *10*). The TCRβ transgene is expressed on the cell surface in the absence of TCRα proteins in both normal (*11*) as well as in rearrangement-defective mice (*7*, *8*, *12*) in an 80-kD disulfied-linked complex and as a glycosyl-phosphatidylinositol (GPI)–linked 40-kD monomer.

The presence of the TCRβ chain in the 80-kD complex suggested that either the complex was a homodimer or that an unknown TCR chain was involved that may affect T cell maturation. A glycosylated chain of 33 kD (gp33) is paired with TCRβ proteins in a TCRβ-transfected immature T cell line (SCB.29) from severe combined immunodeficient (SCID) mice (*12*), but could not be identified in normal thymocytes (*12*, *13*). The gp33-TCRβ complex of SCB.29 cells is associated with CD3 proteins (*8*, *12*) and cross-linking of TCR chains initiates Ca^{2+} mobilization. This suggested that this TCRβ complex could be responsible for the developmental progression observed in TCRβ transgenic, rearrangement-deficient mice, whereas the TCRβ GPI-linked monomer could represent a transgenic artifact (*14*, *15*). We have now cloned the gene encoding gp33 and examined its structure and expression. Because of its properties, the gp33 protein was named the pre-TCRα (pTα) chain.

Pre–T cell receptor α (pTα) expression in immature T cells. The pTα chain can be identified by two-dimensional (diagonal) gel electrophoresis, in which the disulfide-linked pTα protein under reducing conditions migrates away from the diagonal just underneath the TCRβ protein (*12*) (Figs. 1 and 2). The analytical method was scaled up to obtain sufficient amounts of pTα protein for microsequencing. In a first attempt a 20-amino-acid-long NH_2-terminal sequence was obtained; a peptide of the 18 NH_2-terminal residues was synthesized and injected into rabbits to obtain a pTα-specific antiserum. The antiserum was tested for binding to the pTα protein. To this end lysates from the TCRα-negative SCB.29 cell line as well as the TCRαβ-expressing B6.2.16BW hybridoma (*12*) were precipitated with the monoclonal antibody (mAb) F23.1 to $V_\beta 8$ proteins (*16*). Precipitates

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